SEA STARS*

FROM THE ARCTURUS OCEANOGRAPHIC EXPEDITION.

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Although the number of species brought back by the *Arcturus* was not large, a number of new distribution records were established. I am much indebted to Mr. William Beebe for the privilege of examining this material, a list of which follows:

Family Porcellanasteridae.

Thoracaster magnus Ludwig.

Thoracaster magnus Ludwig, *Zool. Anz. vol.* 31, 1907, *p.* 313; *Clark*, 1920, *p.* 78, *pl.* 1, *fig.* 1, 2.

Type in U. S. National Museum.

Station 53, D. 2, Lat. 1° 51′ S., Long. 89° 50′ W. (tropical eastern Pacific) 1733 fathoms, 1 specimen.

The known range of this species is from latitude 1° 51′ to 8° 30′ south and longitude 85° 19′ to 98° 56′ west. The type and 8 other specimens were dredged by the *Albatross* in from 2,005 to 2,370 fathoms, between latitude 4° and 8° south, mostly on globigerina ooze; bottom temperature 35.2° to 35.5° Fahr.

Thoracaster, like most other members of the archaic though highly specialized Porcellanasteridae feeds upon the mud in which it burrows. The stomach is large and simple, occupying the entire disk. There is no dorsal chamber of the stomach similar to that which is characteristic of most sea stars. Instead the dorsal wall is closely juxtaposed to the wall of the disk as in the Ophiuroidea. In sea stars the large central aperture (or actinostome) of the ventral skeleton of the disk is framed by 5 pairs of first ambulacral plates (radial in position) and 5 pairs of jaws (interradial in position). In Thoracaster the ambulacral elements are longer than I have noted in any other sea star and the whole frame is unusually flexible. Very probably fairly large objects such as molluscs and sea urchins can be ingested along with the ooze.

The stomach of the specimen contained, however, only mud—about 9 cc., which filled it. This mud is predominantly calcareous, consisting of foraminifera. Treatment with acid reveals several genera of diatoms and radiolaria, sponge spicules, a little volcanic dust (about the size of the diatoms), and flocculent organic material comprising perhaps 10% of the whole bulk. It is undoubtedly rich pabulum.

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Family ASTROPECTINIDAE.

Leptychaster inermis (Ludwig).

Parastropecten inermis Ludwig 1905, *p.* 76; *pl.* 4, *fig.* 21, 22; *pl.* 21, *fig.* 117; *pl.* 22, *fig.* 126.
Leptychaster inermis Fisher 1911, *p.* 53; Clark 1913, *p.* 188.

Station 74. OT4, Lat. 4° 50′ N., Long. 87° 00′ W. (tropical eastern Pacific) 625 fathoms, 1 specimen (R 12 mm., r 6 mm., R=2 r.).

The other specimens are two dredged by the Albatross in 695 fathoms off Panama, on green mud, bottom temperature 39° Fahrenheit; 1 off Lower California, 645 fathoms; and 2 from off Monterey Bay, California, 659 to 871 fathoms.

The species is evidently a Leptychaster and is quite distinct from *L. anomalus* Fisher (Sea of Japan, Bering Sea, southern Alaska). The present specimen is a little more delicate than Ludwig's type, with relatively narrower marginals. In general form it resembles *L. propinquus* (Fisher, 1911, pl. 9, fig. 3) but of course has broader superomarginal plates. *Inermis* has 6 or 7 furrow spinelets; *anomalus* 3 or 4.

For a discussion of the generic position of *inermis* see Fisher 1911, p. 53. The practical difficulty of recognizing Parastropecten for the short-armed species of Leptychaster is here pointed out. Nevertheless Verrill later attempted to maintain two genera (1914, p. 328), although for Parastropecten he used *Glyphaster* Verrill, 1909. The generic diagnosis was probably based upon one specimen of *L. anomalus*, since it does not apply to some of the variants of *anomalus*, nor to *L. propinquus* or *L. inermis*.

L. inermis ranges from off Panama to Central California. In view of the capture of *inermis* off Monterey (Clark, 1913, p. 188), the tiny specimen of *anomalus* recorded by the writer from 871 fathoms off Monterey is probably referable to *inermis*.

Dytaster gilberti demonstrans Ludwig.

Dytaster demonstrans Ludwig, 1905, *p.* 41, *pl.* 5, *fig.* 23–25; *pl.* 18, *fig.* 97–99; *pl.* 19, *fig.* 107; *pl.* 20, *fig.* 108–115. *Clark*, 1920, *p.* 82.

Type in U. S. National Museum.

Station 53, D. 2, Lat. 1° 51′ S., Long. 89° 50′ W. (tropical eastern Pacific) 1733 fathoms, 6 specimens.

The known range of this species is from latitude 10° 14′ north to 8° 30′ south and from longitude 80° 21′ to 96° 28′ west. The bathymetrical range is 1322 to 2370 fathoms; temperature range 35.2° to 36.4° Fahrenheit.

There can be little doubt that the range of this form is continuous with that of *D. gilberti* Fisher from off San Diego, California, 2,196 to 2,228 fathoms. The range of variation of *gilberti* is not known, since only 2 specimens are in existence. In *demonstrans* the paxillar area is narrower and is evenly tapered from the base to end of ray whereas in *gilberti* (besides being broader) it is scarcely tapered at all for a third of the length of ray, and then rather more rapidly than in *demonstrans*. On the outer half of ray of *gilberti* the dorsal surface is conspicuously narrower than the ventral so that the marginal plates slope inward like a roof (Fisher, 1911, pl. 17, fig. 1.). In *demonstrans* the sides of the ray are nearly perpendic-

ular. The furrow comb consists of 11 or 12 spinelets; in *gilberti* of 10 (sometimes 8 or 9).

It seems to me likely that *gilberti* and *demonstrans* intergrade and that each is a race of a wide ranging abyssal species, for which the name *gilberti* has priority.

The Arcturus specimens were taken on foraminera mud along with *Thoracaster magnus*. Unfortunately the stomachs of all the specimens were washed clean.

Psilaster florae (Verrill).

Archaster florae Verrill, *Amer. Journ. Sci., vol.* 16, 1878, *p.* 16.
Psilaster florae Verrill, *Proc. U. S. Nat. Mus., vol.* 17, 1894, *p.* 255

Station 113, Lat. 39° 15′ N., Long. 72° W. (western Atlantic), 633 fathoms, 1 specimen.

A long-known species probably, at best, a race of *Psilaster andromeda* of Europe.

Astropecten americanus (Verrill).

Archaster americanus Verrill, *Amer. Journ. Sci., vol.* 20, 1880, *p.* 402.
Astropecten americanus Verrill, *Proc. U. S. Nat. Mus., vol.* 17, 1894, *p.* 255; 1915, *p.* 184, *pl.* 6, *fig.* 1, 1*a*.

Station 113, Lat. 39° 15′ N., Long. 72° W. (western Atlantic), 633 fathoms, 18 specimens.

Verrill (1915) regards this as the most abundant starfish off the Atlantic coast of the United States, if the littoral species of Asterias are excepted.

"It occurs abundantly from N. lat. 40° 23′ to the region of the Carolina coasts. Farther south it seems to be less common, but it reaches the Florida Straits, West Florida, and the Caribbean Sea, off Colombia.

"It was most abundant in 60 to 150 fathoms, where 2000 to 5000 were repeatedly taken by us in a single haul of the trawl" (Verrill, 1915, p. 186). Verrill records 43 to 296 fathoms as the extreme range. The Arcturus specimens are recorded as from 633 fathoms.

Döderlein places this species in his *Articulatus* group, on the border between the *Articulatus* and *Brasiliensis* groups (1917, p. 106).

Family Odontasteridae.

Odontaster hispidus Verrill.

Odontaster hispidus Verrill, *Amer. Journ. Sci., vol.* 20, 1880, *p.* 402; 1899, *p.* 206, *pl.* 29, *fig.* 3, 3*a*; 1915, *p.* 119, *pl.* 13, *fig.* 6.

Station 113, D. 1, Lat. 39° 15′ N., Long. 72° W. (western Atlantic) 633 fathoms; 6 specimens.

Verrill (1915) says: "This species was taken by the U. S. Fish Commission at many localities from off Marthas Vineyard to Florida, in 43 to 480 fathoms and more."

The specimens upon which *Odontaster setosus* Verrill are based need very critical reëxamination. It seems probable that *setosus* is a forma of *hispidus* as the two often occur together. Four of the 6 Arcturus specimens are referable to *setosus*, one to *hispidus* while one is intermediate.

Family Goniasteridae.

Nymphaster diomedeae Ludwig.

Nymphaster diomedeae Ludwig, 1905, *p.* 128, *pl.* 10, *fig.* 48, 49, 52, 53; *pl.* 11, *fig.* 54, 55.

Station 74, OT4, Lat. 4° 50′ N., Long. 87° W. (tropical eastern Pacific south of Cocos), 625 fathoms, 1 specimen.

Ludwig records this species from four stations of the Albatross between 0° 04′ south and 6° 35′ north and 81° 44′ and 90° 24′ 30″ west (Galapagos, Gulf of Panama), in from 384 to 885 fathoms; temperature range 37.2° to 43.3° Fahrenheit, globigerina ooze, green, and gray sand.

Family Oreasteridae.

Nidorellia armata Gray, 1840.

Two specimens without locality record. The species occurs from Ecuador to the Gulf of California.

Family Linckiidae.

Ophidiaster guildingii Gray.

Ophidiaster guildingii Gray, *Ann. Mag. Nat. Hist.*, 1840, *p.* 284.

Station 23, Lat. 17° 39′ N., Long. 63° 16′ W. (Saba Bank, Lesser Antilles), 2 specimens.

This is the West Indian equivalent of the Mediterranean *O. ophidianus*. Clark (1921, p. 79) states that the species ranges from the Tortugas to Tobago. The writer has collected it at Barbados and Antigua, well within this range.

Family Poraniidae.

Porania insignis Verrill.

Porania insignis Verrill, *Amer. Journ. Sci.*, *vol.* 49, 1895, *p.* 138.

Station 113, D. 1, Lat. 39° 15′ N., Long. 72° W. (east of Cape May), 633 fathoms, 6 specimens.

When taken from formalin these specimens were mottled orange red and Vandyke red.

In his original description Verrill records that this species was taken by the Albatross at numerous stations from latitude 41° 28′ 30″ to 36° 38′ 30″ (as well as on the "Banks" by Gloucester fisherman) in from 65 to 373 fathoms. The Arcturus record therefore greatly increases its bathymetrical range.

Poraniella echinulata (Perrier)

Marginaster echinulatus Perrier, *Bull. Mus. Comp. Zool*, *vol.* 9, 1881, *p.* 17.
Poraniella echinulata Verrill, *Ann. Mag. Nat. Hist.*, *vol.* 14, 1914, *p.* 20; 1915 *p.* 73.

Station 23, Lat. 17° 39′ N., Long. 63° 16′ W. (Saba Bank), 1 specimen.

Poraniella is probably the young stage of an unknown adult. The present specimen has R 5. 75 mm. and resembles Verrill's figure of *P. regularis* (1915, pl. 7, figures 1, 1a), which seems to the writer to be but a variation of *echinulata* (figured by Perrier, 1884, pl. 1, fig. 6, 7).

Family ECHINASTERIDAE.

Henricia sanguinolenta (Müller)

Asterias sanguinolenta O. F. Müller, *Zoologiae Danicae Prodromus*, 1776, *p.* 234.

Station 113, D. 1, Lat. 39° 15′ N., Long. 72° 00′ W. (east of Cape May), 633 fathoms, 3 specimens.

These appear to represent a deep water variety of the widely distributed *sanguinolenta*, having unusually delicate abactinal spinelets and papular areas broader than the intervening spiculated ridges of the plates. R. 25 mm. r. 5.5. mm.

Family MITHRODIIDAE.

Mithrodia bradleyi Verrill.

Mithrodia bradleyi Verrill, *Trans. Conn. Acad.*, *vol.* 1, 1869, *p.* 288.
Fisher, 1906, *p.* 1094, *pl.* 36, *fig.* 1, 2; *pl.* 37, *fig.* 1-3.

Chatham Bay, Hood Island, Galapagos Archipelago, 1 specimen. Known also from Lower California and Hawaiian Islands.

Family ZOROASTERIDAE.

Zoroaster ackleyi Perrier.

Zoroaster ackleyi Perrier, 1884, *p.* 197, *pl.* 3, *fig.* 1.
Clark, 1920, 102.

Station 23, Lat. 17° 39′ N., 63° 17′ W. (Saba Bank, Lesser Antilles), 1 specimen, R 127 mm.

Off Pensacola, Florida, 525 fathoms to Montserrat 120 fathoms.

Clark gives a good key to the species of this genus.

Family ASTERIIDAE.

Coronaster briareus (Verrill)

Asterias briareus Verrill, *Amer. Journ. Sci.*, *vol.* 23, 1882, *p.* 220.
Coronaster briareus Verrill, 1915, *p.* 31, *pl.* 1, *fig.* 1, 2; *pl.* 9, *fig.* 4–4c.

Station 113, D. 1, Lat. 39° 15′, long. 72° 00′ W. (east of Cape May), 633 fathoms.

Verrill, 1915, p. 32, states that the species was dredged by the *Albatross* at several stations in 31 to 373 fathoms between north latitude 37° 18′ 11″ and 36° 41′ 05″. The Arcturus specimen therefore furnishes the deepest and most northern record. It has been taken in 75 to 110 fathoms off Florida.

The unguiculate, hand-shaped, straight pedicellariae are rather scarce in the Arcturus specimen.

For a discussion of the relationships of this genus see Fisher, 1919, p. 494.

Sclerasterias tanneri (Verrill)

Asterias tanneri Verrill, *Amer. Journ. Sci.*, *vol.* 30, 1880, *p.* 401.
Orthasterias tanneri Verrill, 1914, *p.* 48, 168; *pl.* 48, *fig.* 6.
Sclerasterias tanneri Fisher, *Bull. l'Inst. Oceanographique*, *No.* 444, *July* 31, 1924, *p.* 4; *Bull. U. S. Nat. Mus. 76*, part 2, 1928, *p.* 107.

Station 111, D. 2, lat. 38° 00′ N., Long. 74° 02′ W., 382 fathoms, 1 specimen.

Station 113, D. 1, Lat. 39° 15′ N., Long. 72° 00′ W., 633 fathoms, 12 specimens, badly broken.

Verrill records this species as ranging from north latitude 35° 10′ to 40° 08′ and from 40 to 194 fathoms. The Arcturus specimens greatly increase the known bathymetrical range.

When taken from formalin the specimens retained apparently some of the natural coloration, being Vandyke red in general tint, the base of spines pinkish purple.

Asterias vulgaris Verrill.

Asterias vulgaris Verrill, *Proc. Boston Soc. Nat. Hist., vol.* 10, 1866, *p.* 349.

Station 113, D. 1, lat. 39° 15′ N., long. 72° 00′ W., 633 fathoms, 1 specimen; (1 other specimen, locality doubtful).

In shallow water the species ranges from Labrador to the eastern part of Long Island Sound, while in deep water it continues on to the neighborhood of Cape Hatteras. The deepest record heretofore known is 358 fathoms.

Asterias forbesi (Desor).

Asteracanthion forbesi Desor, *Proc. Boston Soc. Nat. Hist., vol.* 3, 1848, *p.* 67.

Station 109, D. 1, Lat. 36° 56′ N., Long. 75° 28′ W., 36 metres, 1 young specimen, R 18 mm.

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